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CONTENTS

FEATURES

- 6** COVER STORY
*Larry Fullerton: New challenges,
new perspectives*

- 28** SPECIAL ADVERTISING SECTION
Hi-tech revolution

NEWS

- 13** Jason Dorwart: Paralyzed actor knows his role
27 Built Green builds upon sturdy foundation of committed members
35 Built Green members shine at E-Star awards

DEPARTMENTS

- 7** Energy Waves
14 In The News
17 New Members
22 Home Builders Foundation
24 Boulder County Chapter
26 Annual Membership Meeting
38 Calendar
41 Buyer's Guide
43 Renewals/Spike Club Report
44 Stats



PAGE 6
2003 HBA President



PAGE 22
Home Builders Foundation



PAGE 26
Annual Membership Meeting

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HVAC: 'V' stands for 'Ventilation'



Steve Andrews

Every systems-built home needs an effective ventilation system. Most homes don't have one. Here's a starting point.

You need a complete package when pursuing the systems approach to designing and building healthy, comfortable, durable, energy-efficient and environmentally responsible homes. The essentials include combustion safety, moisture management, good thermal performance of the shell, and whole-house mechanical ventilation. Unfortunately, most new homes don't come with that last essential.

A properly designed and installed whole-house ventilation system provides fresh air, filters and mixes the air, then distributes that air around the house, all with minimal maintenance. Several systems readily available today range in price from \$200 to \$2,000 installed.

Normal noisy bath fans don't qualify, as they're typically run such a small fraction of the day that the air-exchange they achieve is insignificant. Most Colorado homes don't even have a kitchen exhaust fan. If homeowners don't wash out the grease traps in their kitchen recirculating range hoods, the crud trapped up there might eventually qualify as a toxic mini-dump.

Building science experts indicate that first-cost may not be the major barrier to lack of effective mechanical ventilation in the residential sector today. They cite the absence of good understanding of the entire issue.

"I don't think the public really knows much about ventilation and their options," says John Bower, author of *Understanding Ventilation* and president of the Health House Institute. "They rely on builders, and most builders haven't offered much. Until builders talk about it, ventilation systems will remain the exception. As time goes on and ventilation evolves, people will be willing to pay more for ventilation. In recent surveys, when people are asked about

healthier houses, they say they would be willing to pay between \$1-\$2K for a good ventilation system."

Today in Colorado, entry-level whole-house ventilation systems, costing a fraction of that figure, are being installed by a handful of large production builders including Engle Homes, McStain Enterprises, Centex/Fort Collins and Oakwood Homes of Denver. Opting for a well-thought-out system provides their buyers with better quality air. The builders themselves then garner a sales edge and some liability protection.

Changing current practice

Mark LaLiberte, building science trainer and materials supplier (Shelter Supply; Minneapolis), stresses a counterintuitive angle: "The only way to get proper relative humidity and good indoor-air quality starts with tightening up the shell."

For a lot of builders, first tightening up a house and then mechanically ventilating it is wacky. Why not just let the necessary fresh air enter through natural leakage, then equip the house with a few bath fans and a small kitchen fan and call it good?

Trouble is, natural leakage is uncontrollable and unpredictable. During some months homeowners will get too much weather-driven air exchange and on many days they won't get any. Rarely does natural leakage "distribute" the infiltrating outdoor air evenly around the home. As several building science researchers aptly put it when talking with homeowners about fresh air in their homes: "Are you feeling lucky today?"

Most bath fans are so noisy they're only used to mask out sounds from the toilet. Typically they get turned off too soon to exhaust any significant water

see *ENERGY* page 8

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vapor in the air during or after bathing.

But change is coming. Building codes in three states already require whole-house mechanical ventilation. During the early 1990s, Washington was the first to mandate fresh air systems. Minnesota followed in 1998 and Vermont's requirement kicked in last year.

Upgraded codes aren't the only driving force here. Eventually, scary mold stories will have an impact on homebuyer receptivity to paying for ventilation.

How much ventilation?

ASHRAE has proposed a residential ventilation standard (62.2P) that could be released by the summer of 2003 or soon thereafter. In its current iteration, 62.2P would require a Colorado builder to install a whole-house ventilation system plus exhaust fans with sound limits (some maximums) in kitchens and all baths. And where standard, atmospherically vented water heaters are installed within the conditioned space, it would require backdraft testing to assure safe operation.

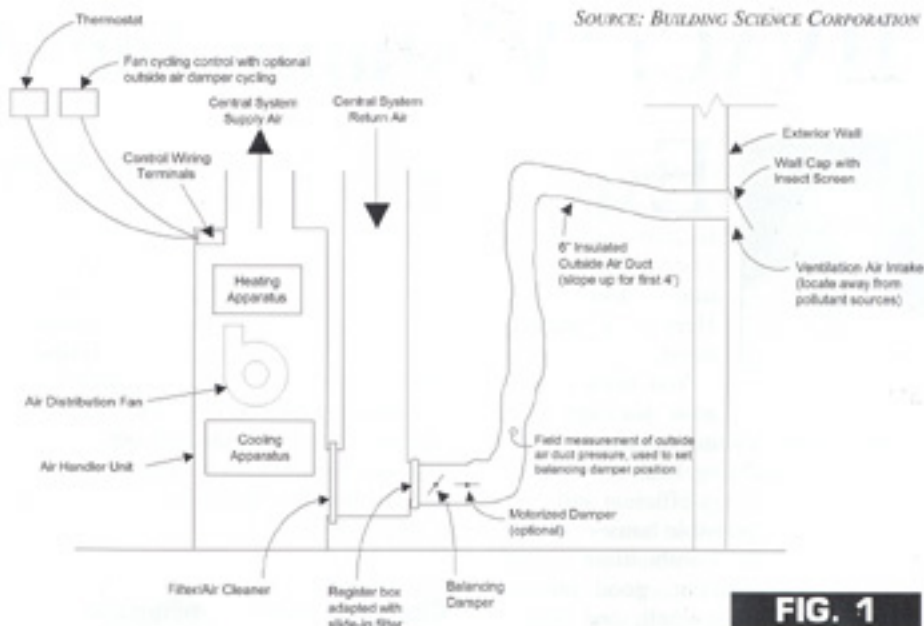


FIG. 1

The latest iteration of 62.2P specifies that home ventilation systems should be sized to supply 7.5 cfm per bedroom plus 0.01 cfm per square foot of conditioned space. For a four-bedroom,

2,000-square-foot home, that translates into 50 cfm.

High-performance-home programs like Engineered for Life and Environments for Living have a simpler formula that gives roughly the same answer: 20 cfm for the first bedroom and 10 cfm for each additional bedroom. For the four-bedroom home, the math still calls for 50 cfm of fresh air.

Indoor-air quality researchers tend to favor continuously operating systems. Field consultants lean more toward what works on a cost-effectiveness basis for their clients. In either case, the objective is to eliminate today's predominant reliance on "accidental ventilation," replacing it with controlled ventilation.

With all three of the generic ventilation options described below, you still need to install a dedicated kitchen exhaust fan to exhaust odors and water vapor plus any combustion gases.

Entry-level ventilation

The central-fan-integrated approach (Fig. 1) is a low-cost, whole-house ventilation option installed in production homes built to the U.S. Dept. of Energy's Building America program standards. Fresh air is ducted — typically through a 6-inch duct with two in-line dampers — to the return-air side of the furnace or central air system. When the blower operates, it draws in a percentage of air from the outdoors; the amount is pre-set

see *ENERGY* page 10

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by the HVAC technician adjusting a manual damper. The outside air mixes with home's return air, runs through the central filter and gets distributed via the central ductwork.

When the system's central fan hasn't operated during mild weather, a special controller — the AirCycler — automatically turns the fan on. According to Armin Rudd, inventor of the controller and consultant to large production builders through Building Science Corp. (Westford, Mass.), here in Colorado the maximum "outside air fraction" — the amount of outside air drawn into the system — should be between 7 percent (in our population centers) and 5 percent (in the mountains).

Rudd reports that the desired run time for the ventilation system is about 10 minutes every half-hour whenever the home is occupied and windows aren't open. When the system isn't moving air, the AirCycler closes a motorized damper in the fresh-air duct. This prevents pooling of unmixed cold air within the return air system that might other-

wise cause warranty problems with heat exchangers in furnaces.

A major comfort benefit of the system is a smoothing out of room-to-room temperature differences. On sunny winter days, homes with south-facing windows can develop cold zones along the north side if the thermostat hasn't called for heat. But since the AirCycler will draw and mix air from all rooms when it periodically brings in fresh air, even temperatures are easier to achieve. When combined with a super-efficient building shell, this comfort benefit helped entry-level builder Artistic Homes (Albuquerque, N.M.) provide a comfort guarantee to all their buyers.

To date, Building America builders have installed roughly 15,000 of these ventilation systems nationwide. According to LaLiberte, an HVAC dealer's cost of materials for the system run roughly \$125 for the controller, a 6-inch motorized damper, plus the additional ductwork, adjustable damper, vent cap and wiring. Once HVAC installers are famil-

iar with the system's features, installed costs should run around \$200. Some code jurisdictions allow the AirCycler system to reduce combustion air requirements by one combustion air duct, which offsets some of the ventilation system's costs.

Exhaust-only ventilation

A second ventilation approach uses a quiet central exhaust fan and dedicated small ducts to extract air from several rooms simultaneously. This approach replaces all of a home's typical bath fans, which helps reduce system costs. Mounted in a remote location such as the attic, a product like an American Aldes or Panasonic fan can barely be heard when it's functioning.

Depending on home size, fan size and the amount of ductwork present, the fan can be set to function either continuously or intermittently. Install an override switch so the fan can be shut off when the building is unoccupied. Dur-

see *ENERGY* page 33



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The AirCycler controller regulates ventilation and increases comfort.

ing showers and bathing, the Aldes fan's airflow rate can be boosted for more effective ventilation of water vapor. Costs for these systems vary with features and number of small ducts; a typical range would be \$600 to \$1,000.

One disadvantage of the exhaust-only system: the incoming "fresh air" comes from uncontrolled locations. If that air enters from a crawl space or attached garage, it is probably bringing pollutants with it. The exhaust systems will also contribute a slight amount of negative pressure to the home — never a good idea if the home has an atmospherically vented combustion appliance (the typical water heater) within the conditioned space. Exhaust-only systems are most appropriate when homes have detached garages, no crawl spaces (or meticulously sealed crawl spaces) and sealed or power-vented combustion appliances.

Ventilation with energy recovery

Ventilation systems with heat recovery cost substantially more — up to \$2,000 installed. The amount depends primarily on whether a dedicated ductwork system is required, such as in a home with hydronic heating, or whether the home's heating and cooling ductwork can provide a boost.

Heat recovery ventilators (HRVs) use a heat exchanger core to condition fresh air drawn in from the outdoors. On the average January evening in Denver, 16 degree outdoor air is warmed up to about 55 degrees by air being exhausted

on alternating sides of the heat exchanger's plates.

To reduce an HRV system's ductwork costs, Building Science Corp. recommends taking exhaust air from the master bedroom and supplying the fresh air into the home's central area. When the thermostat calls for heating or cooling, the centrally supplied fresh air is drawn into the home's conventional ductwork and circulated to all rooms. During mild weather, an AirCycler controller (no duct to the outside needed this time) runs

just 10 minutes an hour to help circulate the HRV's fresh air throughout the home.

A relatively new product entry called the Guardian Plus, sold by Broan-Nu-Tone, has raised the bar for the HRV industry. Priced the same as a standard HRV, the Guardian Plus combines

energy recovery ventilation with High Efficiency Particulate Air filtration (HEPA). Quotes from distributors in Minneapolis and Denver indicate the Guardian Plus costs a dealer up to \$600. The typical cost of installation will vary from twice to three times this amount, depending on the amount of dedicated ductwork.

(During the first cold snap this fall, a couple of buyers with AirCyclers controlling their fresh air systems have complained about cool air flow during fresh-air cycles when heating isn't required. That may increase the demand for affordable HRV options.)

Power draw

Will running ventilation systems increase electric bills? Compared to most homes that just run heating and air conditioning systems, the increase could be \$50 a year. But in some cases, they break even.

Right now, the HVAC industry often

see *ENERGY* page 37



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recommends that blowers be run on low speed 24/7 — not a good idea with an inefficient blower. A 1,000 cfm conventional blower motor operated at low speed consumes about 280 watts of power, and 400 watts at high speed.

Installing a power-saving ECM motor cuts energy consumption by roughly 75 percent, but adds \$400 or so to the purchase price. Most builders won't go that route. But Building Science Corp. says running a conventional blower continuously at low speed uses more energy than running the system at higher speeds 20 minutes per hour to both circulate house air as well as bring in fresh air.

Rudd has field data indicating that the combination of a continuously operating 90 watt HRV plus 10 minutes of extra operation by the central air system blower will cost roughly \$75/year. But that combination system would use less electricity than running the central blower 100 percent of the time either at high or low speed (\$310 and \$240 respectively, with average heating/cooling operation).

Bottom-line concern

Over the past few years, performance analysis of heating and air conditioning systems in Colorado indicate a rash of problems: oversized equipment, lack of calculations supporting ductwork design, poorly installed ductwork, improper airflows, etc. The byword: you get what you inspect, not what you expect.

Similarly, recent studies of ventilation system operation in Wisconsin and Canada indicate that systems need to be installed by people who are also capable of testing the systems as installed to assure they function as intended. Builders need both good performance-based specs and some on-site testing to assure they get what they pay for.

Steve Andrews consults with builders for E-Star Colorado and writes on energy issues (sbandrews@att.net). E-Star, at 303-297-7470 (www.e-star.com), is a nonprofit home energy rating system that works with both new and existing homes statewide. A version of this story first appeared in the November issue of Professional Builder magazine. ■



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